Role of Science and Process for the Expert Regional Technical Group to Assign Survival Benefit Units for Estuary Habitat Restoration Projects

Prepared by the Bonneville Power Administration and the U.S. Army Corps of Engineers

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Science has a fundamental role in the process for the Expert Regional Technical Group (ERTG) for habitat restoration in the lower Columbia River and estuary (LCRE). The ERTG applies the best available science to provide assessments of proposed restoration projects to decision-makers. The ERTG process, which is overseen by a steering committee led by BPA and the Corps, involves extensive interaction with regional partners. Science pervades the ERTG process, starting with the group's origin and composition, phases and work products, the method to assign project benefits for estuary habitat restoration projects, and ending with assigning SBUs to restoration projects, as explained herein. This explanation is applicable generally to regional LCRE stakeholders and specifically to the Comprehensive Evaluation in the remand process for the Federal Columbia River Power System (FCRPS) Biological Opinion.

Purpose, Origin, and Composition

The purpose of the ERTG is to assign survival benefits units (SBU) for ocean- and stream-type juvenile salmon from estuary habitat actions implemented by the Bonneville Power Administration and the U.S. Army Corps of Engineers (the Action Agencies), as called for in the 2008 FCRPS Biological Opinion[A] (BiOp). In Reasonable and Prudent Alternative (RPA) #37, the National Marine Fisheries Service (NMFS) stated,

> "…*To support [restoration] project selection the Action Agencies will convene an expert regional technical group…the expert regional technical group will use the approach*[1] *originally applied in the FCRPS Biological Assessment*[B]*…and all subsequent information on the relationship between actions, habitat and salmon productivity models developed through the FCRPS RM&E to estimate the change in overall estuary habitat and resultant change in population survival*..."

In response to RPA #37, the Action Agencies formed the ERTG in spring 2009. Their intent was to establish a committee of scientists with established scientific credibility in habitat restoration, estuarine ecology, and fisheries biology. Official invitations were sent to selected agencies of the federal government (NMFS), the states of Oregon (ODFW) and Washington (WDFW), a natural resource management cooperative (Skagit River System Cooperative), and a Department of Energy national laboratory (PNNL). Current ERTG members are D. Bottom, G. Hood, K. Jones, K. Krueger, and R. Thom (Table 1). This diverse group of scientists brings a wealth of ecological, biological, hydrogeomorphical, and habitat restoration experience from inside and outside the LCRE.

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[1] This original approach is referred to as the "existing method" and is explained in Endnote #2.

Table 1. ERTG Member Information. Key publications are referenced as endnotes under areas of expertise.

Name	Affiliation	Position	Areas of Expertise
Mr. Dan Bottom	NMFS, Northwest Fisheries Science Center, Newport, OR	Research Fishery Biologist, Estuarine and Ocean Ecology Program	Estuarine ecology, salmon early life history, fish biology[C]
Dr. Greg Hood	Skagit River System Cooperative, La Connor, WA	Senior Research Scientist, Research Department	Estuarine ecology, hydro-geomorphology, botany, wetland restoration[D]
Mr. Kim Jones	ODFW, Fish Division, Corvallis, OR	Leader, Aquatic Inventories Project	Fish biology, habitat restoration, LCRE ecology[E]
Dr. Kirk Krueger	WDFW, Habitat Program, Science Division, Olympia, WA	Senior Scientist, Salmon and Steelhead Habitat Inventory and Assessment Program	Salmon biology, stream ecology, quantitative assessment, statistics[F]
Dr. Ron Thom	PNNL, Marine Sciences Laboratory, Sequim, WA	Technical Group Manager, Coastal Ecosystem Research	Restoration ecology, adaptive management, estuary ecosystem science[G]

Focus Topics and Work Products

There have been several focus topics to the ERTG's development between its inception in June 2009 and its current status as an established scientific body. This development has been documented in ERTG work products[2] delivered to the Action Agencies and the LCRE region.

Formation (June 2009 to July 2010)

The Action Agencies and NMFS convened formal, open meetings with regional stakeholders[3] to explain the ERTG's purpose and responsibilities. Other activities in the formative phase included site visits, presentations, and interchange between the ERTG and project sponsors. Early on, these interactions helped form the ERTG's scientific understanding of habitat restoration activities and data from research, monitoring, and evaluation. This type of interaction between the ERTG and regional stakeholders continues to this day and helps ensure the quality of applied science in LCRE restoration.

Standardization (February to December 2010)

For purposes of repeatability and transparency, the ERTG recognized the need to standardize elements of the existing method to assign survival benefit units. They started with the documentation for proposed restoration projects by creating the "*ERTG Template for LCRE Habitat Restoration Project Summary*." This work product[H] was updated in May 2012. Another aspect of standardization involved development of scoring criteria for three factors in the method to calculate survival benefit units: certainty of success, habitat access, and habitat capacity (explained further below). This work product[I], called "*ERTG Scoring Criteria*," was released to the region in December 2010. Standardization increased the scientific rigor of the ERTG process.

[2] ERTG work products are available from B. Zelinsky (BPA, 503 230 4737, bdzelinsky@bpa.gov).
[3] Examples of regional stakeholders are the Columbia Land Trust, Columbia River Estuary Study Taskforce, Lower Columbia Fish Recovery Board, Lower Columbia River Estuary Partnership, Northwest Power and Conservation Council.

Quantification (August 2009 to December 2010)

The ERTG's most significant scientific contribution to date has been to quantify the assignment of survival benefit units. They modified the existing method's qualitative approach by removing a subjective step and replacing it with an algorithm, as presented in December 2010 in the work product[J] "*History and Development of a Method to Assign Survival Benefit Units*." This algorithm is applies through the SBU Calculator, which is explained in detail below. The SBU Calculator operationalized the scientific underpinnings for assigning survival benefit units for LCRE restoration projects.

Guidance (January 2011 to December 2011)

Regional application and experience with the Calculator led to the need for the ERTG to provide clarifying guidance. For example, practitioners desired better understanding of the ERTG's interpretation of the subactions in the Estuary Module. The guidance phase resulted in two work products, "*Feedback on Inputs to the Calculator to Assign Survival Benefit Units*[K]" and "*Guidance on Estuary Module Actions and Subactions Relevant to the ERTG Process*.[L]" Regional meetings of the ERTG and LCRE stakeholders also serve to exchange information and perspectives and provide guidance and feedback from the ERTG to interested parties. These meetings have been documented in "*ERTG Regional Meeting Notes – 2009 and 2010*.[M]" The guidance phase shows the ERTG's role to provide scientific clarifications and promote scientific transparency and peer-review in the ERTG process.

Scoring (January 2011 to present)

With the Calculator released, the ERTG worked to score a backlog of projects, many of which were constructed during 2007-2010, but had not yet been scored for SBUs. A major push occurred during 2011 when 20 projects were reviewed and scored; see "*ERTG SBU Reports*.[N]" The SBU reports document the ERTG's scientific rationale for scores on a project by project, subaction-specific basis. ERTG review and scoring is anticipated to continue into the foreseeable future. The ERTG applies learning from its activities and RME at projects sites to upcoming project reviews, thereby continually improving and refining the scientific basis for the ERTG process.

SBU Calculator

The ERTG modified the existing method to assign SBUs to increase the method's transparency, repeatability, and quantification. For a given subaction and ocean-type/stream-type life history pattern in the Estuary Module[O], the SBU calculator is:

$$SBU = TotalPossibleSBU * GP * SP * HAP * HCP * WF$$

where,

Total Possible SBU = total possible SBUs for the particular subaction as prescribed in the existing method

GP = Goal Proportion = project goal (acres or miles) divided by the total goal for the particular subaction in the existing method

SP = Success Proportion = mean success score of the ERTG members (scale of 1 to 5) divided by highest possible score (5)

HAP = Habitat Access Proportion = mean access score of the ERTG members (scale of 1 to 5) divided by highest possible score (5)

HCP = Habitat Capacity Proportion = mean capacity score of the ERTG members (scale of 1 to 5) divided by highest possible score (5)

WF = Weighting Factor = optimal fish density divided by fish density for the particular subaction in the existing method.

Development of the ERTG's SBU calculator involved applying additional science to build off key elements of the "existing method" (see Endnote #2). Total possible SBUs and total goals for subaction acreages and mileages are derived directly from the existing method. The ERTG developed the Goal Proportion variable to quantify the contribution of the size of the project relative to the overall goals for acreages and mileages determined in the Estuary Module. In general, larger size enhances habitat stability, increases the number of species that can potentially use the site, makes it easier for migratory species to find the site, and increases within-habitat complexity[P].

The Success Proportion, Habitat Access Proportion, and Habitat Capacity Proportion variables were designed to account for basic elements of restoration science. Success pertains to ecological success in terms of the project's restoration of natural processes, self-maintenance, and expectation for invasions of non-native species[Q]. The restoration approach for a site should be matched to the level of disturbance at the site and in its landscape[R]. Habitat access "appraises the capability of juvenile salmon to access and benefit from the habitat's capacity"[S]. Examples would be tidal elevation and geomorphic features. Habitat capacity involves "habitat attributes that promote juvenile salmon production through conditions that promote foraging, growth, and growth efficiency, and/or decreased mortality"[Q], such as invertebrate prey productivity, salinity, temperature, and structural characteristics. The ERTG assesses these variables in the context of a site's landscape, as recommended by the National Research Council[T], and similar to the landscape approach recently championed for the Northwest Power and Conservation Council's Fish and Wildlife Program[U].

The Weighting Factor was necessary to correct inconsistencies in the relationships between the potential number of juvenile salmon produced and the total possible SBUs as outlined as goals in the existing method. For example, off-channel restoration in the Estuary Module seemed to be under-valued in total SBUs because the estimated fish densities were overly low, whereas riparian restoration was over-valued in the ERTG's experience because the expected fish densities were unreasonably high. To alleviate this issue, the ERTG used the existing method's goals on acreages and survival benefits in terms of total possible fish produced to compute a "Module Fish Density" value (#/m^2). Then, the ERTG ascribed an "Optimal Fish Density" value for each subaction based on an extensive literature review[V]. A weighting factor was derived by dividing the Optimal Density by the Module Density. Weighting does not change the number of SBUs that are possible; it only reallocates SBUs among sub-actions. The ERTG explained the scientific basis for the Weighting Factor in detail[K].

Process

The Action Agencies' philosophy for the ERTG process is that it be transparent, documented, adaptively managed, and science-based. This philosophy is applied as restoration projects progress from initial development through to having SBUs assigned (Figure 1). Transparency is promoted through regional meetings[L] and presentations, such as the ERTG talk at the 2012 Columbia River Estuary Conference[W]. Transparency is also served though documentation, such as the ERTG work products. The Action Agencies strive to maintain the scientific integrity of the ERTG and its process. For example, ERTG members do not work for others to develop restoration projects. The ERTG provides feedback to sponsors during project review activities, but it does not provide official review of project designs. ERTG scoring is conducted in closed-session to avoid bias and maintain fairness to all project sponsors.

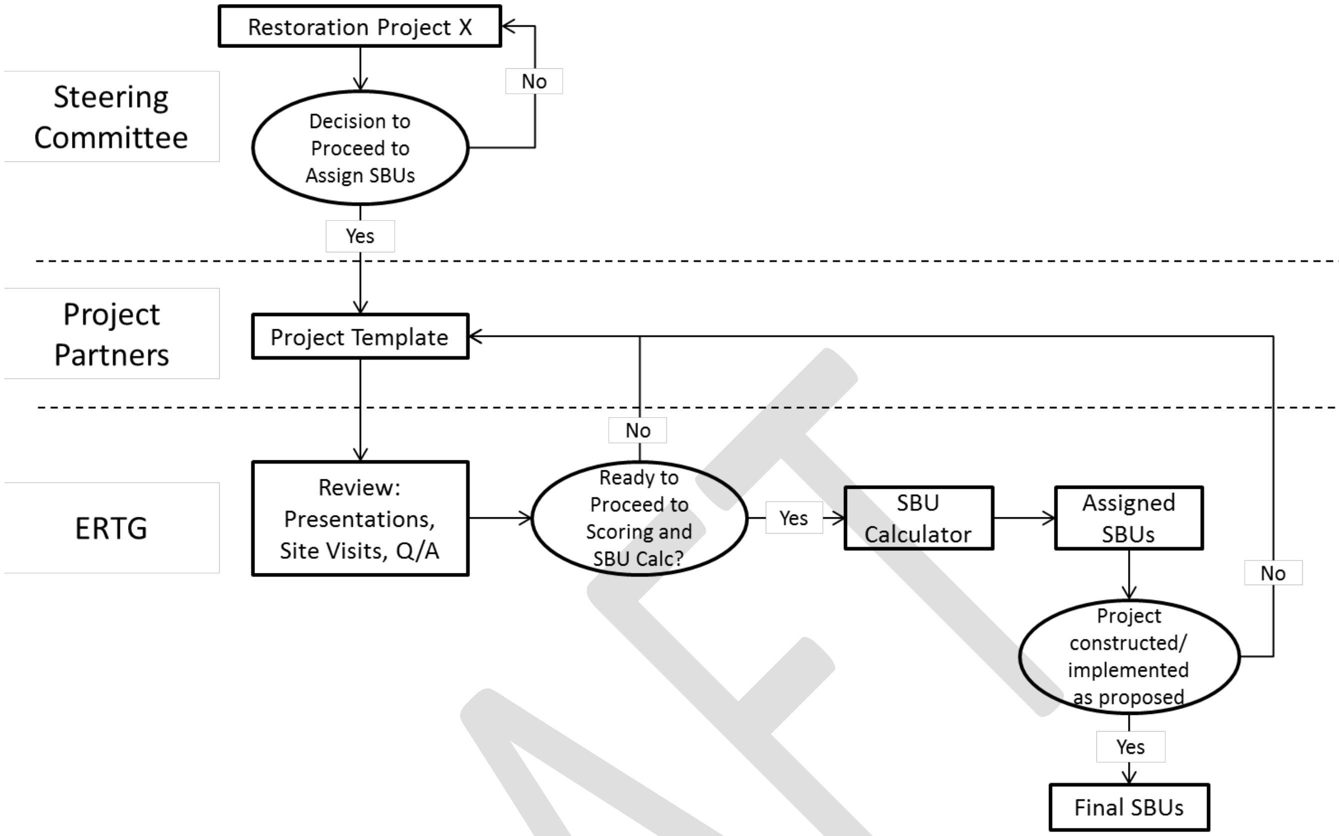

Figure 1. Process from Project Development to Assigning SBUs. ERTG activities are overseen by a Steering Committee led by Ebberts (USACE), Krasnow (NMFS), and Zelinsky (BPA).

The ERTG process allows the AAs to prioritize which actions are most likely to be most influential to juvenile salmonids and it actively incorporates new RME AE findings into those assessments. However, there are limitations to the process, such as uncertainties in the knowledge base for the effectiveness of various restoration actions. (As noted above, the ERTG is currently working to specify uncertainties from their perspective.) When faced with an uncertainty in a project, the ERTG tends to score conservatively. The ERTG recognizes the need for a scientific validation of the SBU calculator, i.e., ground-truth SBUs to measures of salmon performance directly attributable to habitat restoration.

Once a project is ready for its ERTG score, we follow these steps to assign SBUs:

1. Initiation
    a. The Steering Committee prioritizes and selects the project, then requests the sponsor prepare a project template and supporting material.
2. Project Review
    a. Delivery of the project template and supporting materials to the ERTG for them to study.
    b. Presentation at an ERTG meeting involving interchange between the ERTG and the project sponsor. Additional information requested (optional).
    c. Site visit (optional although preferred).
    d. Second presentation at an ERTG meeting (optional).
3. Scoring

    a. Organization of the project into the appropriate subactions and associated Module goals and total possible SBUs.
    b. Review and potential recalculation of acres/miles for project subactions, culmination with values for project subaction goals.
    c. Scoring for certainty of success using the Scoring Criteria. ERTG's comments are documented.
    d. Same for habitat access.
    e. Same for habitat capacity.

4. Calculator
    a. The ERTG facilitator compiles the data from Step 3 in an Excel spreadsheet and runs the Calculator.
5. Review of Results
    a. The ERTG and Steering Committee review and discuss the results.
6. Dissemination
    a. The results for assigned SBUs and scoring comments are disseminated as appropriate.
7. Dialogue and Feedback
    a. An opportunity is provided for dialogue and feedback between the ERTG, Steering Committee, project sponsors, and interested parties.
8. Post-Construction Validation
    a. Implementation and compliance monitoring and AA decision to redo the SBUs based on differences in the design the ERTG scored and what actually was constructed

Conclusion

The entire process is designed to learn from doing, i.e., adaptive management, and the ERTG has been very active in the last three years (Table 2). The role of science is paramount in the ERTG and the process to assign SBUs. This is demonstrated by the ERTG's application of restoration and ecological science to add transparency, repeatability, and quantification to the existing method. Many of the key inputs to the SBU Calculator are quantitative (e.g., water surface elevation and weighting factors based on fish densities). It is clear, too, that professional judgment necessarily will be a prominent element of the process to assign SBUs. Recall, the ERTG scores for success, habitat access, and habitat capacity in the SBU calculator are based on professional judgment using the best available science within a scoring criteria framework[I]. Professional judgment is a common, established tool in processes like assigning SBUs[X]. The key is to combine quantitative metrics with professional judgment consistently, without bias, within a science-based process, and through a group of scientists expert in the subject matter.

Table 2. Summary of ERTG's Project Review Activities from June 2009 through June 2012

Activity	# Projects
Site visits	27
Sponsor presentations	38
Scorings	27*
SBU reports	23

*These are not the same 27 projects that had site visits

Endnotes

[A] NMFS (National Marine Fisheries Service). 2008. Biological Opinion – Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program. NOAA Fisheries Northwest Region, Seattle, Washington.

[B] The "existing method" assigned potential survival improvements accrued to juvenile salmon using and transiting the estuary for each of the 22 actions outlined in NOAA's 2006 *Estuary Module*. The survival improvements were based on a possible 20% total cumulative increases over time in the numbers of both ocean- and stream-type Chinook salmon exiting the estuary relative to annual total numbers of fish entering the Pacific ocean as established in "*Estimation of Percentages for Listed Pacific Salmon and Steelhead Smolts Arriving at Various Locations in the Columbia River Basin in 2006*" NOAA Fisheries Memorandum, April 10, 2006, by J.W. Ferguson. The existing method is described by Trask (2007), "*Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary*" (available from the BPA).

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[F] Krueger, K. L., W. A. Hubert, R. M. Price. 1998. Tandem-set fyke nets for sampling benthic fish in lakes. *North American Journal of Fisheries Management* 18: 154-160.

Krueger et al. 2010. Anticipated effects of sea level rise in Puget Sound on two beach-spawning fishes, in Shipman et al. (eds.), 2010, Puget Sound Shorelines and the Impacts of Armoring—Proceedings of a State of the Science Workshop, May 2009: U.S. Geological Survey Scientific Investigations Report 2010-5254, p. 171-178.

[G] Thom RM. 2000. "Adaptive management of coastal ecosystem restoration projects." *Ecological Engineering* 15:365-372.

Thom et al. 2005. "Balancing the Need to Develop Coastal Areas with the Desire for an Ecologically Functioning Coastal Environment: Is Net Ecosystem Improvement Possible?" *Restoration Ecology* 13(1):193-203.

Thom et al. 2005. "Adaptively Addressing Uncertainty in Estuarine and Near Coastal Restoration Projects." *Journal of Coastal Research* 40(special issue):94-108.

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[H] "ERTG Template for LCRE Habitat Restoration Project Summary." ERTG Doc#2010-01 rev2.

[I] "ERTG Scoring Criteria." ERTG Doc#2010-02.

[J] "History and Development of a Method to Assign Survival Benefit Units." ERTG Doc#2010-03.

[K] "Feedback on Inputs to the Calculator to Assign Survival Benefit Units." ERTG Doc#2011-01.

[L] "Guidance on Estuary Module Actions and Subactions Relevant to the ERTG Process." ERTG Doc#2011-02.

[M] "ERTG Regional Meeting Notes – 2009 and 2010." ERTG Doc#2011-03.

[N] "ERTG SBU Reports." ERTG Doc#2011-04.

[O] The SBU calculator uses the final "*Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead*" (NMFS 2011); available at http://www.nwr.noAction Agencies.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Estuary-Module.cfm.

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[R] Shreffler DK and RM Thom. 1993. Restoration of urban estuaries: New approaches for site location and design. Prepared by Battelle−Pacific Northwest Division for the Washington Department of Natural Resources, Olympia, Washington.

[S] Simenstad CA and JR Cordell. 2000. "Ecological Assessment Criteria for Restoring Anadromous Salmonid Habitat in Pacific Northwest Estuaries." *Ecological Engineering* 15:283–302.

[T] The National Research Council (NRC 1992, pp. 347–348) viewed landscape ecology as a method for designing integrated aquatic ecosystem restoration projects. It concluded that, "*Wherever possible...restoration of aquatic resources...should not be made on a small-scale, short-term, site-by-site basis, but should instead be made to promote the long-term sustainability of all aquatic resources in the landscape*."

[U] ISAB (Independent Scientific Advisory Board). 2011. *Using a Comprehensive Landscape Approach for More Effective Conservation and Restoration*. Document ISAB 2011-04, submitted to the Northwest Power and Planning Council, Portland, Oregon.

[V] Key references included: Bass, A. 2010. Juvenile coho salmon movement and migration through tide gates. Master's Thesis, Oregon State University. 125 pp.

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[W] Abstracts, presentations, and a synthesis of the 2012 conference and previous conference in the series are available at www.cerc.labworks.org.

[X] For example, see Weisberg et al. 2008. The level of agreement among experts applying best professional judgment to assess the condition of benthic infaunal communities. *Ecological Indicators* 8:389-394.